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White light can also be produced by a new LED generating only one color of light from its active layer, by doping the substrate with more than one rare earth or transition element. FIG. 3 shows another embodiment of the new LED 34 being nitride based and having a UV emitting multiple quantum well active layer 35 made of InGaN, although other types of active layers can also be used. It is sandwiched between a GaN n-type layer 36 and a GaN p-type layer 37. When a bias is applied across the p-type contact 39 and n-type contact 40, the active layer 35 emits UV light with some of it emitting from the LED surface and some of it passing into the substrate 38. The substrate 38 is doped with Cr which absorbs UV light and emits red light, Titanium (Ti) which absorbs UV light and emits blue light, and Cobalt (Co) which absorbs UV light and emits green light. The red, green, and blue light is emitted from the substrate omnidirectionally, with some of it emitting from the LED's surface to produce white light.

Claims

Replace the corresponding claims in the original application with the following amended claims:

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4. The LED of claim 14, wherein said active region comprises multiple quantum wells or single quantum wells.
5. The LED of claim 14, wherein said substrate comprises a material from the group consisting of sapphire, spinel, silicon carbide, gallium nitride, quartz YAGI, garnet, lithium gallate, lithium niobate, zinc oxide, and oxide single crystal.
6. The LED of claim 14, wherein said substrate is doped